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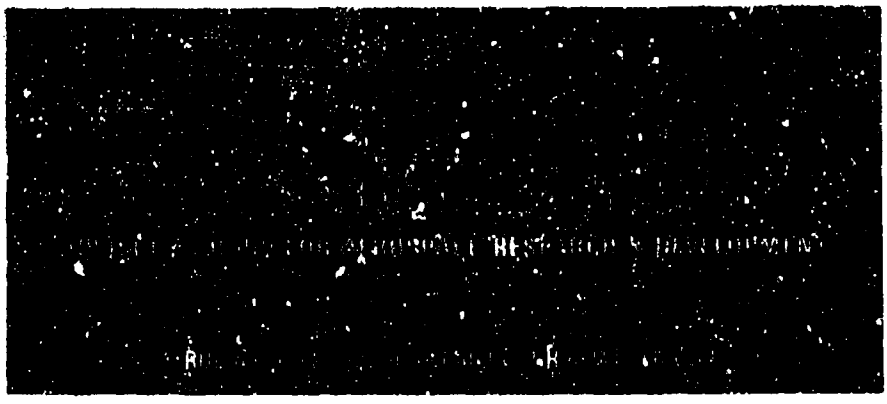

AGARD REPORT No.759

Aerospace Applications Studies 1971–1987

NORTH ATLANTIC TREATY ORGANIZATION

ADVISORY GROUP FOR AEROSPACE RESEARCH AND DEVELOPMENT

(ORGANISATION DU TRAITE DE L'ATLANTIQUE NORD)

AGARD Report No.759

AEROSPACE APPLICATIONS STUDIES 1971–1987

This Report has been prepared at the request of the Military Studies Committee of AGARD.

THE MISSION OF AGARD

The mission of AGARD is to bring together the leading personalities of the NATO nations in the fields of science and technology relating to aerospace for the following purposes:

- Exchanging of scientific and technical information;
- Continuously stimulating advances in the aerospace sciences relevant to strengthening the common defence posture;
- Improving the co-operation among member nations in aerospace research and development;
- Providing scientific and technical advice and assistance to the Military Committee in the field of aerospace research and development (with particular regard to its military application);
- Rendering scientific and technical assistance, as requested, to other NATO bodies and to member nations in connection with research and development problems in the aerospace field;
- Providing assistance to member nations for the purpose of increasing their scientific and technical potential;
- Recommending effective ways for the member nations to use their research and development capabilities for the common benefit of the NATO community.

The highest authority within AGARD is the National Delegates Board consisting of officially appointed senior representatives from each member nation. The mission of AGARD is carried out through the Panels which are composed of experts appointed by the National Delegates, the Consultant and Exchange Programme and the Aerospace Applications Studies Programme. The results of AGARD work are reported to the member nations and the NATO Authorities through the AGARD series of publications of which this is one.

Participation in AGARD activities is by invitation only and is normally limited to citizens of the NATO nations.

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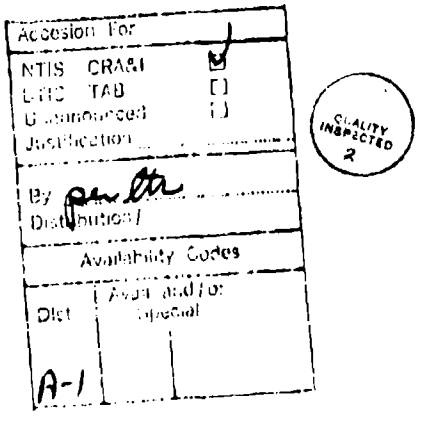
INTRODUCTION

The Aerospace Application Studies Programme has been a major AGARD activity since 1971. At that time, the AGARD Steering Committee proposed a major reorganisation within AGARD that created the Aerospace Applications Studies Committee (AASC) and the Military Studies Committee (MCS) Division. Since that time the Military Committee has provided topics of interest from which studies have been recommended by the AASC and approved by the Steering Committee and the National Delegates Board. These studies have been accomplished by experts nominated by the nations and other NATO groups under the supervision of the AASC.

The studies have sought to apply technologies expected to be available in the 1995—2010 timeframe to anticipated operational requirements. The teams have been composed of scientists, engineers and military specialists. Important contributions have been made by each.

To date, twenty-two studies have been completed. They have all been based on broad technical questions with operational application. The studies have been concerned with several aspects of airpower including the protection of aircraft in combat, the improvement of their avionics, weapons delivery or communication and defence against tactical ballistic missiles.

The following are titles and abstracts from the first twenty six Aerospace Applications Studies. All but the final five studies are presently available through the National Distribution Centres for classified publications (see list on back cover). AAS-22 is in the final stages of publication and AAS-23 and AAS-24 should be published in the Spring of 1987. To obtain an Executive Summary, ask for Volume I only of the desired report.



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AAS NO 1

AR-47

THE PHYSICAL VULNERABILITY OF AIRCRAFT

Volume 1: September 1972
Volumes 2 & 3: May 1973

The overall utility of combat aircraft is influenced by the ability of the vehicle to absorb damage and still complete its mission and/or be repaired and returned to service rapidly. The report develops analysis techniques by which this characteristic of the aircraft may be assessed during the initial design phases and measured quantitively as design features are established. The report also summarises and evaluates the techniques which have been developed to reduce the physical vulnerability of aircraft.

The third volume, separately entitled "Aircraft Vulnerability Analysis", by consultant D.Kardels, describes a detailed computer model for assessing the physical vulnerability of an aircraft to a variety of weapons. It illustrates the use of the model with examples by evaluating three weapon types — 20, 30 and 35 mm shells — against the RF-84E aircraft. The model provides sub-routines for describing the target and threat, for evaluating the effect of the weapon on the components of the aircraft and, finally, for assessing the impact of component damage upon the survivability of the aircraft.

The Report (Volumes 1 & 2) is NATO CONFIDENTIAL
The Supplemental Analysis (Volume 3) is NATO SECRET

AAS NO 2

AR-57

SMALL TACTICAL MISSILES FOR THE 1980S AND BEYOND

Two Volumes: December 1973

The case is made in this report for a NATO approach to tactical missile developments for the 1980s via technology programmes which lead into "building block" programmes of major sub-systems having applications to more than one missile system. The case is then made for linking together these various separate development programmes into a planned development programme involving families of closely associated missiles.

Based on a comprehensive survey of the advances in sub-system technologies and supporting techniques available in 1980–1985 and on the estimated characteristics of the targets of the 1980s, this method of approach leads to the definition of some 80 conceptual system designs corresponding to 41 missile system types classified into 7 target orientated missile families. These conceptual system designs are analysed in order to derive the cases for commonality and modularity and the most promising technologies and techniques for the 1980s.

The Executive Summary, published in English – AR-57/1 and French — AR-57/1 (FR), is NATO CONFIDENTIAL
The Main Report, AR-57/2, is NATO SECRET

AAS NO 3

AR-59

DETECTION AND LOCATION OF SHELTERED AND DISPERSED AIRCRAFT

Two Volumes: July 1974

This report is a survey of the means for detecting and locating sheltered and dispersed aircraft. The nature of these targets and their environment is examined and the military requirements for reconnaissance, attack and damage assessment are reviewed.

The text provides a survey of information on a wide range of both well-established and new sensing techniques. The capability of the techniques is considered over the full range of light and weather conditions.

The possibilities of sensor combinations and the problems of information retrieval in real time are explored.

The means of sensing is related to the operational requirements, and conclusions are drawn on the effectiveness of the techniques considered. Recommendations are made for the further development of sensors and proposals are made for trials to supplement operational performance data on existing sensors and to test the operational effectiveness of novel sensing systems.

The Report is NATO SECRET

AAS NO 4

AR-79

APPLICATIONS OF UNMANNED AIRCRAFT

Three Volumes: April 1975

The primary goals of the study are to identify the roles and effectiveness of Remotely Piloted Vehicles (RPV)/Drones and to identify major technology areas requiring more effort in order to achieve the capability to perform these roles.

As a first step, the study group assumes an operational concept of supplementing tactical air forces by the use of RPV/Drones to carry out conventional attack against vital counter-air targets.

As a second step, the study group conducts analyses including many trade studies to define the subsystem performance required to arrive at a weapon system concept for the operational mission.

As a third step, two design approaches are undertaken. One design effort considers a drone vehicle configuration to be employed for area denial operational missions. From this configuration an RPV Point Design 1 is derived by incorporating additional avionics for remote control and attack of offensive counter-air targets. The configuration developed incorporates a modular design concept to permit easy changes of the fuselage nose and antennae for alternate missions. The second design, Point Design 2, is a larger flight vehicle carrying a heavier payload. This design is configured primarily for the close air support mission. The purpose of the point designs is to provide two significantly separated base points for performance variations.

As a fourth step, the RPV/Drone capabilities are analysed quantitatively by considering subsystem and system cost, weapon delivery survivability/vulnerability and life cycle cost. In addition, Point Design 1 is compared to a manned aircraft employing long range stand-off missiles to attack targets in order to estimate the cost effective comparisons between these two tactical weapon systems.

This approach provides a step-by-step advancement from an attack drone (area weapon) to an attack RPV and finally to the more sophisticated autonomous terminal attack drone.

AAS NO 5

AR-73

NIGHT VISION DEVICES FOR FAST COMBAT AIRCRAFT

Volumes 1, 2 & 3: December 1975
Volume 4: May 1982

The goal of this study is to assess the utility of night vision devices in high subsonic speed aircraft operating at night against a variety of tactical targets.

This study considers the integration of night vision devices into the total aircraft weapon system. A methodology for addressing these questions is developed which includes such factors as the target and aircraft characteristics, terrain features, and the contrast between the target and its background. The methodology stresses the human factors aspects of the man-machine interface, especially display size and image quality.

The outputs of this method of analysis take two forms. The first indicates the range of time, before reaching the target, at which a pilot needs to have seen a target and made the decision that it was the proper target. The second output indicates the range at which the man-machine combination is actually able to make such a target-acquisition decision. The study thus identifies the range at which a sensor must be capable of presenting a discernible image on a display and the range by which the pilot must have seen the displayed target and committed his aircraft to an attack in order to be within the manoeuvre restrictions of the altitude-velocity conditions of the attack. The effects of masking and the resultant ranges at which the target first becomes unveiled are next examined. This determines the time history of the target appearing on the display, the pilot's search time, the range at which he turns to attack, and whether this manoeuvre occurs early enough to permit actual attack.

This study does not go through the details of a system design, but rather takes state-of-the-art designs in a parametric trade between field of view and range and examines their performance for one winter month and one summer month. This investigation has purposely not considered the effect of the threat environment.

For meaningful results upon which to base real decision, the calculations developed in Volumes 1–3 needed to be extended throughout a year and around the clock in order to gather useful statistics concerning the effects of weather. Volume IV accomplishes this for one location of interest.

- Statistical data on the interaction of weather with EO imaging sensors (FLIR and TV) throughout a full year in a typical centre Europe area.
- The corresponding basic computed atmospheric transmission data over different paths and to study the sensitivity of these data to the weather conditions.
- The impact of improving technology on capability for air-to-ground tasks such as weapon aiming, navigation and piloting.

The Report is NATO-SECRET.

AAS NO 6

AR-88

USE OF PRECISION POSITIONING SYSTEMS BY NATO

Volume 1: July 1976
Volume 2: January 1977
Volume 3: March 1977

The study concentrates on an evaluation of the potential applications within NATO of a precision positioning system (PPS) — as exemplified by the US NAVSTAR Global Positioning System — with special emphasis on a qualitative and quantitative evaluation of the impact of increased position information accuracy on the tactical air attack capability of NATO in Europe in the 1980s and beyond.

The relative advantage of a satellite system vis-à-vis other systems is discussed as well as the optimum number of satellites and the costs and effectiveness of tactical bombing with manned and unmanned aircraft using PPS. The ability of such a PPS to support military missions other than tactical air, as well as civilian applications, is also discussed.

The study concludes that a secure and very precise PPS is feasible. With such a system, the all-weather attack capability (less than 10 metres in the three dimensions) on stationary, and even some moving, targets is so promising that continuing operational analyses should be performed. Moreover, in the specific area of guidance of manned and unmanned aircraft, as well as stand-off missiles, PPS could lead to outstanding simplifications and money savings. However, the study also identifies the need for a unified command, control, and communications system.

The Executive Summary, AR-88/1, is NATO-CONFIDENTIAL
The Main Report, AR-88/2, is NATO-SECRET

AAS NO 7

AR-91

TECHNIQUES FOR SUPPRESSION OF RADARS ASSOCIATED WITH SAMs

Volume 1: January 1977
Volume 2: April 1977

The study identifies and examines various techniques expected to be available in the 1980s for the suppression of radars associated with surface-to-air missiles for the purpose of reducing the vulnerability of NATO aircraft to SAMs.

The study concentrates on the two basic means of suppressing radars associated with SAMs, namely by destruction or by neutralization. In the area of neutralization all reasonable types of countermeasures are evaluated with respect to surveillance, target tracking, missile tracking, missile guidance, fuse, and availability status. In the area of destruction several types of weapon guidance systems are evaluated with a number of attack variables such as range, warhead weight and type of attack. The report includes a survey on future enemy SAMs and one on electronic intelligence. Recommendations include indications of preferred tactics and desired R and D.

The ultimate question of SAM radar suppression is whether destruction or neutralization is the preferred approach or if the answer is a mixture of the two. Therefore the report includes a model for performing trade-off comparisons between the two means of suppression and highlight deficiencies in input data required to exercise the model properly. The expertise of the study group, enhanced by battle experience, is used to provide inputs to the model in order to portray some trends as well as demonstrate the utility of the model.

The Report is NATO SECRET.

AAS NO 8

AR-102

INTERCEPTION OF MACH 3 AIRCRAFT BY FIGHTERS

Two Volumes: April 1978

The study objectives were to identify (a) feasible Intercept Fighter Systems (consisting of manned aircraft, fire control systems, and air-to-air missiles) for the near term (1977—1985) and the long term (1985—2000), (b) tactics for the employment of these systems, and (c) the most promising area for R&D.

To achieve these goals the assumptions and assessments regarding the high altitude/high speed threats to NATO Europe for the present and for the future, are formulated and the characteristics and performances are identified for existing and in-development NATO Air Defence Environment Systems in Europe defending against these threats (i.e. control and reporting systems such as NADGE and AWACS). As a second step, an evaluation is made of current and in-development Intercept Fighter Systems in order to identify the deficiencies of these systems and consequently the areas most pertinent for parametric studies. Third, criteria are defined for a parametric analysis of technical and operational problems which must be solved to overcome present deficiencies. These parametric studies permit the identification of fruitful areas for R&D effort and allow one to address the overall problem of positioning interceptor aircraft in Europe to meet the high-altitude threats. As a fourth step, an overview is presented of the potential R&D efforts that could be pursued to improve NATO high altitude intercept capabilities.

The study concludes that it is possible to propose options for alternate solutions and to identify advantages and drawbacks of each potential solution. The study also suggests a number of general conclusions and recommendations.

Both Volume I, the Executive Summary, AR-102/1, and Volume II, Technical Appendices, AR-102/2, are NATO SECRET.

AAS NO 9

AR-103

ADVANCED TECHNOLOGY TO COUNTER LOW ALTITUDE THREATS
(other than aircraft-mounted radars)

Volumes 1 and 2: November 1977
Volume 3: June 1980

Current efforts to cope with low altitude threats have centered on specialized airborne radars, and in some cases associated air-to-air missiles. This study investigates alternative techniques that might be brought to bear in the future against threats at low — actually, very low — altitude (below 500 feet above the ground).

To set the stage for the analysis that follows, the first half of the report presents: first, the threat (present and future); second, the current response; third, an assessment of likely deficiencies in the 1980s; and fourth, the operational requirements.

The second half of the report is an analysis of the sensing techniques available, and their application in conventional and unconventional ways. The approach is as follows: (a) determine the physical characteristics of the threat; (b) examine applications of sensors to exploit these characteristics; and (c) identify conceptual system solutions. Some methods for neutralizing the threat are included, as are the problems of early warning and IFF identification.

Finally the conclusions, recommendations, and priorities for R&D effort are presented as well as an essay on "a new philosophy" for defence against low level attacks.

The Report is NATO SECRET

AAS NO 10

AR-120

COMMUNICATIONS DEVICES SUPPORTING AIR WARFARE WITH REDUCED SUSCEPTIBILITY TO JAMMING, INTERCEPT AND LOCATION DETERMINATION

Volume I: August 1979
Volume II: April 1980

Most communication systems supporting aerospace operation are susceptible to jamming, intercept and direction finding. Jamming would make combat operations extremely difficult without effective counter-countermeasures (CCM). This study investigates various measures available to reduce the susceptibility to the threat.

The study considers all relevant communication characteristics starting with the critical operational situation in close air support, tactical air control and defence and stand-off controls and guidance of remote munitions and vehicles. Technical aspects including link criteria and modulation are discussed.

Parametric identification of system susceptibility to intercept, location determination and jamming is made and possible countermeasures techniques discussed.

A comparative analysis is made to identify a suitable system and parametric analysis is made of trends in R&D of new communication systems. Specific recommendations for related R&D projects are made.

The Report is NATO SECRET.

AAS NO 11

AR-121

SUPPRESSION OF DETECTION AND GUIDANCE SYSTEMS OTHER THAN RADAR, ASSOCIATED WITH SAMs, ASMs, AND GUIDED BOMBS

Two Volumes: August 1979

The study addresses enemy detection and guidance systems, other than radar, associated with SAMs* and ASMs*/guided bombs in order to recommend tactics, techniques and areas for research to counter-act these systems.

The Study Group has considered the application of countermeasures to EO/IR guidance systems used in threats posed by SAMs, ASMs and guided bombs. A survey was made of such basic considerations as equipment usage, technology descriptions, atmospheric physics and human capabilities. Official estimates of the current and future threat were augmented by Study Group with additional technically feasible threat possibilities.

After reviewing all the possible means of countermeasures (CM), e.g. shielding, obscuration, camouflage, passive and active decoys, jamming etc. Countermeasure Applicability and Implementation Matrices have been prepared relating the SAM and ASM/Guided Bomb threats to the physical possibilities of the different means of CM and to possible CM hardware implementation.

In order to demonstrate the dependence of CM effectiveness upon the mission and target type, 7 exemplary scenarios have been considered for SAM and ASM operations and value judgements on CMs were made by the group for each scenario. Finally specific recommendations in R&D related to the various phases of the study are given.

The Report is NATO SECRET.

AAS NO 12

AR-177

POSSIBILITIES FOR ACHIEVING ACCURATE ASM DELIVERY FROM LONG RANGE AND LOW AND HIGH ALTITUDE

Two Volumes: August 1981

The objective of this study was to describe long range air-to-ground stand-off missile systems which the WP might be able to develop in the near term. Possible means to counter the threat originating from these systems for NATO were to be considered.

Concentrating on guidance aspects, the study assesses the possibilities and the effectiveness of long range air-to-surface missiles flying at both low and high altitudes in the attack of a variety of fixed and mobile (NATO) targets.

The activities recommended as a result of the study include counters as well as implications for NATO attack systems.

The Report is NATO SECRET.

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*SAM: Surface-to-air missile
ASM: Air-to-Surface missile

AAS NO 13

AR-196

POSSIBILITIES FOR REDUCING RADAR, INFRARED, ACOUSTIC AND OTHER SIGNATURES ON AN AIR VEHICLE

Two Volumes: November 1982

The study examines the possibilities of the reduction of the ability of an adversary to observe the presence of an air vehicle by reducing radar, infrared, acoustic, visual, laser and other signatures; the practicability and the penalties in performance, operational utility and cost.

The study group has determined the relative importance of air vehicle designs in terms of probability of detection and recognition. It has explored ways and the practicability of reducing these signatures, and assesses their impact on the air vehicle performance and design. The study also evaluates the penalties of performance, operational utility and cost of these methods.

The Report is NATO SECRET.

AAS NO 14

AR-197

MISSION APPLICATIONS FOR V/STOL COMBAT AIRCRAFT

Two Volumes: December 1982

The objective of this study was to determine whether vertical/short take-off and landing (V/STOL) aircraft could serve as an attractive complement to conventional take-off and landing (CTOL) aircraft for certain missions in the future.

The study assesses the state of technology and derives design configurations for several categories of V/STOL aircraft concepts which could be employed in a future force mix.

The activities recommended as a result of the study include technological avenues to be pursued as well as a V/STOL flight demonstrative programme to be initiated.

The Report is NATO SECRET.

AAS NO 15

AR-199

ACTIVE, SEMI-ACTIVE AND PASSIVE SURVEILLANCE SENSORS AND FIRE CONTROL FOR AIR DEFENCE

Three Volumes: March 1983

The study objectives include identification and qualification of the relative advantages of the different air defence systems working within an agreed threat. The study examined their vulnerability to attack in jamming and ARM conditions and discusses the ability of different systems to maintain a defensive capability over an agreed period of time.

The evaluation of relative costs for further developing current active systems compared with the cost of passive, semi-active, or mixed systems is also considered.

The Report is NATO SECRET.

AAS NO 16

AR-200

STAND-OFF SYSTEM CONCEPTS FOR THE ACQUISITION AND NEUTRALISATION OF MOBILE SURFACE TARGETS

Two Volumes: June 1983

The study describes possible weapon systems which could be built and deployed by the year 2000 for the attack of mobile, hard targets at ranges to encounter 2nd echelon forces. The use of these systems against other high value targets is also considered. Target detection, command and control and acquisition/recognition subsystems together with their relevant key technological areas are described. Possible enemy countermeasures have been assessed. Appropriate R&D avenues for promising concepts are identified. Total cost is discussed.

The Report is NATO SECRET.

AAS NO 17

AR-201

OPTIONS FOR FUTURE INTERCEPTOR WEAPON SYSTEM

Volumes 1 and 2: January 1984
Volume 3: March 1984

The study explores the best balance between aircraft performance and weapon performance for a future manned interceptor force which would be effective and cost effective in the longer term (2000 A.D.).

The objective is to conduct a parametric study of air launched manned interceptor weapon systems in order to establish conceptual characteristics and cost of:

- missile with speeds up to hypersonic
- fire control systems for missile types above
- air vehicle size and weight

Emphasis is placed on relative cost effectiveness and other measures of effectiveness for the multiple engagement environment. The air vehicle is assed to be optimised for the air defence role.

The Report is NATO SECRET.

AAS NO 18

AR-214

ATTACK AND DEFENCE OF HELICOPTERS CONDUCTING TACTICAL OPERATIONS

Three Volumes: January 1985

The study identified and selects the most promising solutions to the problem of detecting and destroying advanced WP combat helicopters, and the problem of protecting one's own helicopters. Specifically it will:

- determine the desirable characteristics of different systems and techniques appropriate to the timescale and an agreed scenario.
- study their feasibility including operational constraints and limits and assess the vulnerability of helicopters to such systems.
- select the most promising systems and techniques.
- identify shortcomings of today's technology and the lines along which research should be directed to realize the systems recommended by the study.
- establish effectiveness and probable costs of the solutions proposed.

The Report is NATO SECRET.

AAS NO 19

AR-215

ALL WEATHER CAPABILITY OF COMBAT AIRCRAFT

Three Volumes: January 1985

The study concerns research for identification of the most promising techniques for achieving considerable improvement in the all-weather capability of combat aircraft. Specifically the study:

- analyses techniques and technologies which could be available within the 1990–2000 timeframe.
- selects the most promising techniques and system concepts.
- identifies the lines along which research and development should be guided to realise the system concepts recommended.
- establishes system performance and probable cost for the solutions proposed.

The Report is NATO SECRET.

AAS NO 20

AR-219

ANTI-TACTICAL BALLISTIC MISSILE SYSTEM CONCEPTS

Three Volumes: February 1986

The study develops and compares alternative system concept for the defence of ground forces and facilities against tactical ballistic missile attacks. Specifically it:

- establishes the characteristics of the threat weapon systems in service in the year 2000 and their vulnerable phases
- develops system concepts for anti-TBM (ATBM) weapons and associated early warning and target acquisition systems
- For each concept assesses the performance requirements and effectiveness against the variety of TBM threats
- Creates preliminary designs and cost estimates for promising ATBM system concepts
- Focuses on threat systems classified as TBMs and with a range not exceeding 1000 km. Makes excursions to examine performance requirements for systems capable of defeating SS-20 missiles where the potential of previously defined systems can be simply extended to meet that threat.

The Report is NATO SECRET.

AAS NO 21

AR-221

C³I REQIREMENTS FOR THE ATTACK OF MOBILE TARGETS BY LAND BASED AND AIR LAUNCHED WEAPONS

Three Volumes: October 1986

Within the European land/air environment, the study considers the performance likely to be required by C³I for the acquisition/attack of mobile and other time sensitive ground targets by land based and air launched weapons. The study time frame covers two decades from 1984/1985. Specifically the study:

- establishes target characteristics, locations and environments
- determines C³I needs for current and projected air and ground launched weapons
- analyses the capabilities of current C³I systems
- develops C³I system concepts to overcome existing deficiencies
- for each C³I concept establishes performance data and assesses the effectiveness of the total attack system
- creates preliminary designs and cost estimates for promising system concepts
- recommends improvements for high pay-off.

The Report is NATO SECRET.

AAS NO 22

AR-241

SYSTEMS CONCEPTS FOR THE SUPPRESSION OF ENEMY GROUND TO AIR DEFENCES IN AID OF OFFENSIVE AIR SUPPORT OPERATIONS

Three Volumes: April 1987

The study investigates a wide range of systems for the suppression of enemy ground to air defences by destructive or non-destructive means within the European environment during the 1995--2000 time period. Both manned and unmanned systems are addressed to obtain insights into high payoff technology areas that can be applied to minimize tactical aircraft losses during Offensive Air Support (OAS) operations. Specifically the study:

- investigates technology alternatives for advanced system concepts that can effectively suppress enemy air defences
- defines manned and unmanned suppression systems including surface-to-air laser weapons
- evaluates tactics and assessment of technologies to include the cost effectiveness aspects
- considers advanced conceptual SEAD systems performing in autonomous and/or co-operative operational modes
- analyses the effect of prolonged suppression activities on WP missile logistics and resupply.

The Report is NATO SECRET.

AAS NO 23

AR-242

IMPROVED SELF-PROTECTION FOR TACTICAL AIRCRAFT (THREAT WARNING, END-GAME COUNTERMEASURES AND MANOEUVRE)

Three Volumes: Forthcoming

The study analyses the dynamic relationship of threat warning, end-game countermeasures and aircraft manoeuvre against highly manoeuvrable threat missile systems. The study develops advanced self-protection concepts that integrate equipment and aircraft manoeuvre to defeat the next generation Air-to-Air and Surface-to-Air missiles which are expected to have better detection and tracking sensors and better manoeuvrability. This time frame is from the present to the year 2000. Specifically the study:

- develops a family of future missile threats including tracking, guidance and fusing, range, speed and manoeuvrability
- analyses possible means to obtain threat warning
- analyses possible end-game countermeasures that could defeat the threat guidance and tracking
- examines the dynamic interaction between the threat and end-game countermeasures with and without aircraft manoeuvre
- estimates costs and installation implications of the most promising self-protection concepts
- recommends effective measures in the design of new aircraft.

The Report is NATO SECRET.

AAS NO 24

AR-250

UNMANNED AIRBORNE AIR DEFENCE SYSTEMS FOR MEDIUM TO LONG RANGE AIR-TO-AIR ENGAGEMENTS

Three Volumes: Forthcoming

This study identifies unmanned weapon systems concepts for the airborne air defence beyond visual range. It describes system solution in terms of effectiveness, service requirements, and cost in comparison with manned aircraft systems. Additionally, it highlights the areas of technological risks. Specifically it:

- identifies promising system concepts and operational techniques
- determines the characteristics and cost of these systems

- describes the associated equipment on board and on the ground
- investigates applications of advanced information and image processing techniques for target recognition and/or tracking
- specifies suitable weapons and identifies areas of performance improvement
- examines feasibility of these systems, including operation restraints and analyses their operational effectiveness
- compares the merging concepts with typical manned NATO aircraft systems in terms of effectiveness and cost
- identifies areas to reduce technological risks.

The Report is NATO SECRET.

SCHEDULE
Start: November 1985
End: November 1986

AAS NO 25

AR 251

SYSTEM CONCEPTS FOR NATO TACTICAL (THEATRE) MISSILE DEFENCE

Three Volumes: Forthcoming

This study addresses defensive system architectures capable of countering the tactical missile threat to NATO-Europe (emphasising primarily the precision non-nuclear threat). Alternative defence system architectures to counter the threat are formulated and evaluated for maximum cost effectiveness. Associated technology requirements for acceptable system performance are determined. Budget and forces structures are emphasised in developing recommended approaches. Differentiation between ACE Regions and, if necessary, other areas/sub-areas have been made as appropriate. Specifically it:

- updates and extends the characterisation of the threat weapon systems to include tactical ballistic missiles and cruise missile capabilities
- provides parametric analysis to relate effect of varying threat performance against main target sets
- considers the near time situation based upon the known threat and, within the parametric analysis, cover threat projections and conceptual responses with a timeframe up to 2010
- postulates WP missions against NATO-Europe
- derives Warsaw Pact over-target requirements for postulated campaigns
- formulates system and battle management (BM) C^3 architectures to counter the spectrum of tactical missile threats
- considers both active and passive defence measures
- identifies potential active and passive countermeasures and counter tactics in response to candidate defence architectures
- establishes the performance requirements for each concept and determine its growth potential and effectiveness against the threat element
- identifies the most promising concepts and technologies for future research and development by NATO emphasising affordability and practicability

SCHEDULE
Start: June 1986
End: June 1987

AAS NO 26

AR-252

AN AIR-LAUNCHED STAND-OFF DELIVERY SYSTEM FOR ANTI-SUBMARINE WARFARE AIRCRAFT (ASW)

Three Volumes: Forthcoming

When delivering a torpedo attack the aircraft has to overfly or nearly overfly the target. With the advent of submarine launched anti-aircraft missiles, there is a requirement for a capability to launch an attack from outside the anti-aircraft missile engagement zone. The critical factor will be the delivery accuracy of a stand-off torpedo. It is necessary to place the weapon close to the target to ensure acquisition, particularly if countermeasures are likely to be employed by the submarine.

Mid-course guidance update of the delivery missile will probably be necessary as existing error budget may already be near the ideal limits. Specifically the study:

— established the feasibility of producing an air-launched stand-off torpedo delivery system for ASW aircraft

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This volume provides the abstracts for systems related studies called Aerospace Applications Studies (AAS's) performed by AGARD under the supervision of the Aerospace Applications Studies Committee and the Military Committee Studies Division.

These reports present the results of one year study efforts performed by ad hoc teams made up of members from the nations and military staffs. Included in the volume are the abstracts from AAS-1 published in 1972 through AAS-26 to be published in 1988.

This Report has been prepared at the request of the Military Studies Committee of AGARD.

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